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A Method to Estimate Rates of Dissipation of Turbulent Kinetic Energy and Temperature Variance from Moored Temperature Sensors

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We demonstrate a simple method that allows estimation of the rates of dissipation of turbulent kinetic energy, ε, and temperature variance, χ, from time series collected with moored temperature sensors. If the measurements of temperature fluctuations produce a well resolved spectra in the inertial-convective range, the spectra, as a function of the wavenumber, k_x, should exhibit a -5/3 slope in log-log coordinate space. A fit to the spectra provides an estimate for the product of ε and χ. If a direct measurement exists that allows an independent estimate of either ε, or χ, the other quantity can be estimated from their product. In the absence of a direct measurement one may still arrive at separate estimates for ε and χ if an assumption that $K_\rho = K_T$, where K_ρ and $K_T$are the eddy diffusivities for density and heat, is valid.

The estimates we report here are based on measurements taken off the Kuwait coast during the 2^{nd} half of July, 2017. We used inexpensive, commercially available, temperature sensors with response times of $\sim$0.7 sec and sampling rates of 2 Hz. To reduce possible mooring wake effects, each temperature logger was mounted on a wing assembly, free to rotate, which directed the sensor tip into the flow. We note that conversion of frequency to wavenumber spectra requires knowledge of the flow speed which is based here on current profiles from an ADCP at the mooring site.